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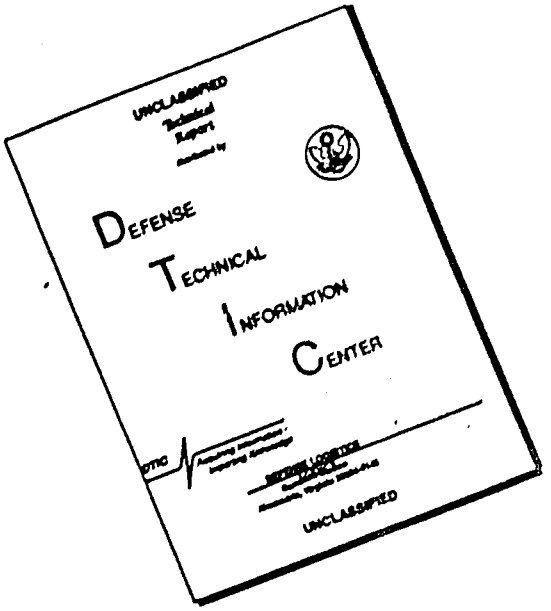

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(JOINT ARMY-NAVY-AIR FORCE)

SOME ASPECTS OF THE DESIGN OF BOOSTERS

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01.0	"Introduction to the Use of Military Standards (Nos. 300-399)"	8/23/55
02.0	"Ground or Water Functioning Test for Use in Development of Fuzes"	8/23/55
03.0	"Check List for Establishing a Testing Schedule for Guided Missile Fuzes and Safety and Arming Mechanisms"	1/18/56
04.0	"Target Functioning Test for Use in Development of Impact Fuzes"	6/20/56
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06.0	"Target Impact Ruggedness Test for Use in Development of Fuzes Incorporating Delay after Impact"	6/20/56
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TITLES OF PRECEDING JANAF JOURNAL ARTICLES (CONT)

Serial No.	Title	Date Approved
15.0	"Methods of Measuring Arming Distances of Rocket Fuzes"	2/11/58
16.0	"A Procedure for Measuring Functioning Characteristics of Acceleration Armed Fuzes"	12/8/59
17.0	"Physical Properties of Explosives and Inert Materials whose Physical Properties Resemble those of Explosives"	3/1/60
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SOME ASPECTS OF THE DESIGN OF BOOSTERS

INTRODUCTION

The main charges of high explosives ordnance are as insensitive as it is practical to make them. The elements which are sensitive enough to respond to the firing signal should be as small as feasible. Neither the detonators used in ordnance, nor the connecting leads which usually form parts of fuze explosive trains are generally sufficient to initiate main charge explosives. Boosters are elements of sufficient sensitivity to detonate reliably when initiated by detonators or leads and of sufficient output to reliably initiate detonation of the main charge.

THE FUNCTION OF THE BOOSTER

The material, loading sensitivities, and confinement of leads and detonation base charges are such that the detonation conditions (propagation velocity, pressure, temperature, etc.) are essentially those of a plane wave detonation*. Thus, since boosters do not generally contain more brisant explosives than the elements used to initiate them, they cannot be expected to intensify any of these conditions. Their function is, rather, that of increasing the size of the "detonation head" in which these conditions prevail. A brief consideration of the structure of the "detonation head" will help to clarify the importance of its size.

For the purpose of this consideration the "detonation head" is defined as the moving region in which the pressure is substantially raised. At any given time, the pressure variation plotted along a line parallel to the direction of propagation has the general form shown in Fig. 1. The shock front is a surface of nearly infinitesimal thickness at one side of which the pressure, temperature, etc., are at their initial value and on the other side of which the pressure is at its peak. In the reaction zone, the composition, temperature, and pressure, change progressively. The nature

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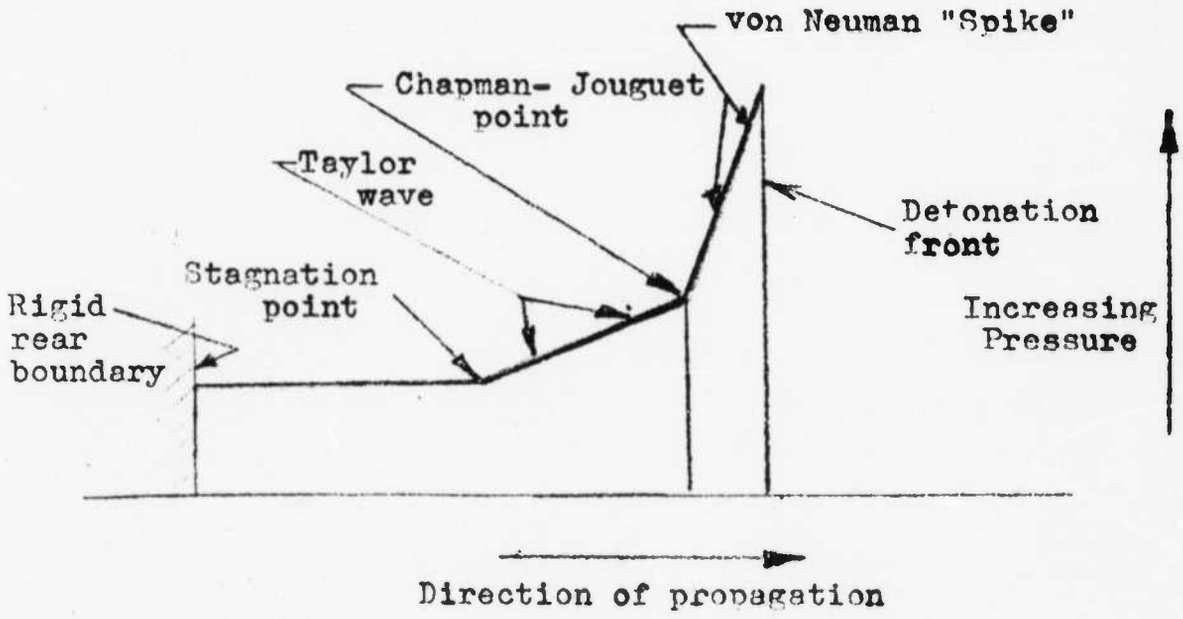
*From the determinancy of the detonation transition, which was established theoretically by early investigations[1], it follows that the absence of diameter effects in the detonation velocity is evidence that other conditions are also unaffected by diameters. When loaded at densities similar to those used in explosive train components, booster type explosives detonate at very nearly plane wave velocities[2].

Fig. 1 Pressure-Time Profile in Detonation



of the reaction, and consequently the relationship between compositions and locations within the zone is still the subject of some controversy. Since the pressure is determined in part by the local equation of state and, consequently by the local composition, the form of the pressure profile within the reaction zone cannot be delineated with confidence. The pressure at the "Chapman-Jouguet point", where the reaction is essentially complete, is determined by equation of state of reaction products and the "heat of detonation" - energy liberated in the reaction. In view of the facts that the reaction products of the common high explosives are mixtures of carbon monoxide, carbon dioxide, carbon, hydrogen, water and nitrogen, and that the density at the Chapman-Jouguet point may exceed two grams per cubic centimeter, it is quite clear that the equation of state is far from that of an ideal gas. The most useful equations of state for the reaction products of high explosives are empirical expressions derived from detonation data. The empirical equations of state have been used with the classical hydrodynamic theory of detonation, to compute the Chapman-Jouguet conditions for plane wave detonations of common military explosives given in Table I.

TABLE I

IDEAL DETONATION CONDITIONS FOR VARIOUS EXPLOSIVES

Explosive	Loading Density gm/cc	Detonation Velocity D, cm/ μ sec		C-J Pressure P, megabars		Particle Velocity, cm/ μ sec	
		Calculated	Measured	Calculated	Measured	Calculated	Measured
RDX	1.80	0.875 (a)		0.349 (a)	0.348 (b)*	0.224	0.216
TNT	1.64	0.695 (a)	0.695 (b)	0.2066(a)	0.177(a)	0.178	0.155
TNT	1.58		0.688 (c)	0.190*	0.177(c)		0.163 (c)
TNT	0.624		0.380 (c)	0.026(c)		0.11 (c)	
Comp B	1.712		0.802 (b)	0.275*	0.293(b)		
Cyclotol (75/25 RDX/TNT)	1.743		0.825 (b)	0.297*	0.313		
RDX	1.762 (d)		0.862 (d)	0.327*	0.325(d)		
Comp B(63%RDX)	1.67 (d)		0.787 (d)	0.252*	0.272(d)		
TNT	1.64		0.695 (b)	0.197*	0.178(b)		
Cyclotol(78/22)	1.755 (a)	0.829		0.311(a)	0.317(a)	0.213	0.218

*Empirically calculated using $P = D^2/4$

(a) Ref. 3 (b) Ref. 4 (c) Ref. 5 (d) Ref. 6

Conditions behind the "Chapman-Jouguet Point" are determined by the rarefaction waves which follow the detonation from the rear and close in from the surfaces of the explosive charge.

In Fig. 2 are shown some typical isobaric contours of detonation heads as they might exist in simple cylindrical explosive charges. These contours have been sketched on the basis of qualitative considerations of the principle outlined by Eyring and his associates in Reference (7). Among the more significant of these principles is the relationship between front curvature, reaction zone length, and detonation conditions. The conditions at the Chapman-Jouguet point approach those for plane wave detonation as the radius of curvature and the length of the "head" as defined above become large compared with the reaction zone length. Conversely, as has been shown by Eyring et al, detonation will fail if the radius of curvature is smaller than a certain "critical radius" which is related to the reaction zone length by the "order" of reaction which applies.

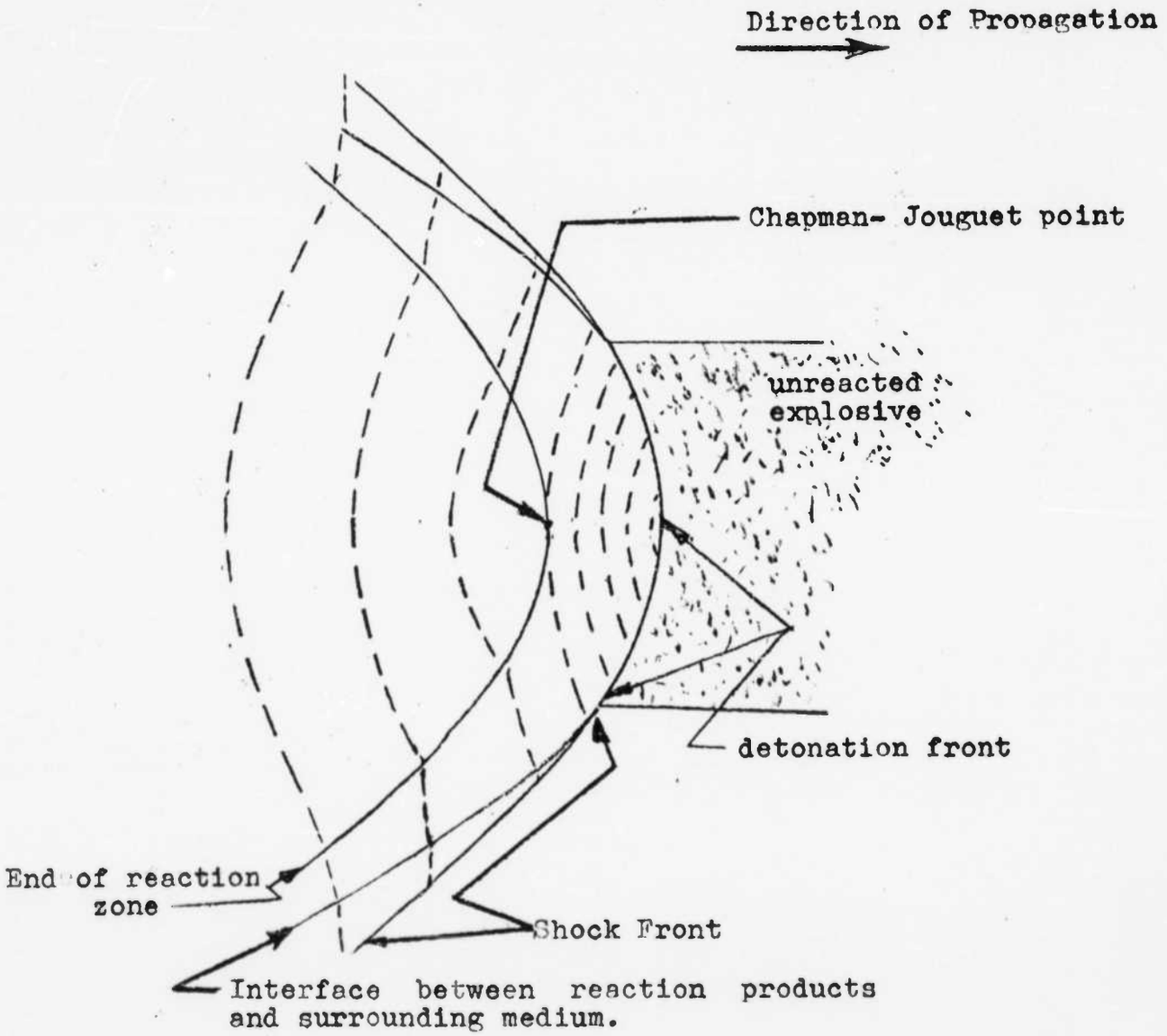
An important function of a booster, then, is to increase the radius of curvature of the detonation front to a value which is significantly larger than the critical radius of the explosive to be initiated. In this respect, the use of relatively crude wave shaping systems in boosters has been found to give substantially improved fragmentation and fragment velocity of TNT loaded shells.[13]

Reaction zone lengths are related to loading density and particle size as well as composition , For TNT, for example, values ranging from 0.02 mm to 5.61 mm were obtained in the same set of experiments. In general, the reaction zones of the insensitive materials used in main charges are longer than those of booster explosives.

The "failure diameter" of a column of explosive has been related by Eyring et al[9] to detonation front curvature and is, thus, a good practical criterion of the "critical radius" and, in turn, of the diameter of booster necessary to initiate a material. Failure diameters of common main charge explosives from Reference 14 are: less than a half inch for Compositions A and B and HBX-1, between 1 inch and 1 1/4 inch for TNT and baronal and 1 1/4 inch to 1 1/2 inch for baratol.

The reaction zone length may be considered as a constant characteristic of an explosive material only when conditions at the Chapman-Jouguet points are quite close to those for a plane wave detonation if, due to the encroachment of rarification waves, the pressure and consequently, the temperature is also reduced and the reaction zone lengthened. This lengthening of the reaction zone allows additional time and space for the encroachment of rarefication waves. This degenerative process continued, can lead to failure of the detonation. Because of the relatively lower reaction rates of main charge explosives, detonation in these materials is more subject to this sort of degeneration than that in primary and booster explosives.

Fig. 2 Detonation Head in a Cylindrical Charge
(Broken lines are isobars)



A second function of a booster is that of retarding the arrival of rarefication waves until the main charge explosive has time to react.

Considered from a slightly different viewpoint, the function of a booster is that of establishing a reaction nucleus in the main charge such that the rate at which energy is liberated by the reaction is greater than that at which it is lost through the surface of the nucleus. Since the loss rate is related to the area of the nucleii, and hence the square of a linear dimension, while the rate at which energy is liberated is related to the volume, and hence the cube of a linear dimension of the nucleus, the balance between evolution and dissipation of energy becomes more favorable as the dimensions of the nucleus are increased. Thus, the function of a booster is that of creating and sustaining a reaction nucleus in the main charge which is sufficiently large to sustain the reaction.

The essential distinguishing feature of a booster as compared with other explosive train components is its size.

BOOSTER EXPLOSIVES

For many years tetryl was the standard booster explosive. At the time of this writing, it is still in more widespread use for this purpose than any other. In recent years the use of other explosives (particularly RDX and some of its mixtures) has been found advantageous for one reason or another. Many of the principal rules of thumb, practices, and procedures which serve as guides in the design and loading of explosive components and systems derive in part from the properties of tetryl. For this reason, tetryl has served as a standard of comparison for booster explosives, and the development of some materials has been a deliberate effort to match its properties.

SENSITIVITY

An essential feature of any ordnance explosive item is the safety provision of the fuze. This feature would lose its point if the sensitivity of the booster were not limited. On the other hand, as pointed out above, the booster must be sensitive enough to detonate reliably when initiated by means of a detonator or explosive lead. Thus the maximum and minimum allowable limits of the sensitivity of a booster explosive must be closer together than those of explosives for other uses. Considerations of economy of design of explosive systems and of the validity of safety and reliability determinations tend to compress these limits still closer.

The lack of a generally agreed upon numerical characterization of sensitivity has led to the establishment of comparative criteria for the sensitivity of explosives. For reasons discussed above, tetryl served as the original comparative standard. The Navy continues to specify that "no material more sensitive than tetryl shall be used beyond the break in

the safety and arming device" of a high explosive ordnance item. The Army has broadened its specification to state that "no material more sensitive than Army Standard RDX shall be used....". *

The use of such comparative standards is not as helpful as it might seem. Not only do the various sensitivity tests assign entirely different numerical values to the sensitivities of various explosives, but they frequently invert the order of sensitivities of some explosives. To make a comparative standard meaningful it is necessary to specify the method of determining sensitivity.

The sensitivities of explosive materials are limited to reduce the danger of premature explosion of the weapons in which they are used. Considered in the light of this objective, the sensitivities of explosives should be compared in terms of the sequences of events which might be expected to lead to premature detonation. These fall into two general classes:

1) direct initiation of the booster or main charge material

2) initiation of the initiators provided for normal operation, which, in turn, initiate the leads and boosters.

To insure against accidental initiation by sequences of the first class, an explosive material should be subjected to a program of sensitivity tests including impact sensitivity tests of various types, friction, static discharge, bullet, and thermal (cook-off). Small differences in values obtained in one or two of these tests should not be viewed with too much concern. They are only qualitative in their significance because:

1) Some, such as most impact tests, are so remote from anything to which the explosives might be expected to experience in services as to be useful indicators only to the extent that a general qualitative ordering of sensitivity of explosives applies.

2) Others, such as the bullet sensitivity test, offer rather little opportunity for closely graded quantitative variation.

3) Most results, but particularly those of the static sensitivity test, are greatly affected by the state of aggregation of the explosive, which is frequently quite different in the test than as loaded.

4) In some tests, such as some of the larger impact tests which simulate service conditions reasonably well, it is not economically feasible to use sample sizes large enough to give statistical significance to any but gross differences.

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* The relative sensitivities of these materials varies with the test. A material more sensitive than either would be rejected.

5) It is hardly possible to assign with any real precision the probability or magnitude of the impulses which may be expected to cause premature initiation.

To guard against hazards of the second class, the sensitivities of booster explosives to initiation by the detonation of other charges must be limited. By means of variable gap or barrier tests, sensitivities of this sort may be measured with quantitative precision under conditions closely resembling those of a fuze explosive system 9, 10. Since the design and evaluation of the safety and arming device of a fuze is based on the expectation that the sensitivity of the explosives used in production will duplicate that of the explosives used in development and proof tests, (see MIL - STD - 315), it is important that this property of an explosive be well controlled. Since the function of a booster demands that it be initiated by relatively small leads or detonators, the minimum as well as maximum sensitivity to initiation by other charges is important.

In specifying tests of this sort, it should be born in mind that initiation sensitivity is a function of a number of variables of the experimental system, including the agency of energy transfer, the confinement of the explosive elements in the test, the state of aggregation of the explosive being tested, and the dimensions of the explosive elements. The effects of these variables interact to make quantitative prediction difficult unless the experiment is a reasonably accurate simulation of the conditions of use. Fortunately, the design and loading practices for leads and boosters are well enough standardized that a relatively modest test schedule can be devised to include conditions representative of all but highly specialized applications. The specifications for the explosive CH-6 (Reference 11) includes tests which bracket the maximum and minimum sensitivity of the material to initiation.

Table II includes sensitivities of various booster explosives as measured by various tests. For comparison a few main charge explosives have been included.

LOADING AND HANDLING PROPERTIES

Most tetryl boosters have been produced using automatic pelleting presses. The pellets are usually inserted in cups or other cases after which they are sometimes reconsolidated. Other techniques which have been used are casting, direct pressing of powdered explosive into cups, and hot pressing of plastic bonded explosives. For the larger production items, the automatic pelleting machines are so convenient that much of the effort in the development of booster explosives other than tetryl has been devoted to the formulation of mixtures in the attempt to approximate or improve upon tetryl in their adaptability to use in these machines. The properties include: (a) free flow of powder, (b) reasonably high and highly reproducible bulk density of powder, (c) high relative density of pellete when pressed at 5000 to 20,000 psi, (d) durability of pellets under normal production handling.

TABLE II

COMPARITIVE INITIATION SENSITIVITY
AND PELLETING PROPERTIES OF BOOSTER EXPLOSIVES

SOURCE REFERENCE / TEST	OSRD[a] Min. Pri. Chg. Cast	OSRD[a] Min. Pri. Chg. Pressed	PA[k] Impact FA In.-lb	NOLW as noted Impact (b) cm	NOLW Crit. Air Gap (0.150In)(0.201n) (Dia.) (Dia.)	NOLW Crit. Ineite Gap[(d)] 50% Gap	NOLW Crit. Ineite Gap[(d)] DBC	PA Crit. Gap Blasting Cap Pellet	NOL PA Tumbling Tests % Loss of wt. of pellet	
EXPLOSIVE										
PETN		0.09	6[k]	11_m - 16_n	0.47(n)					
TETRYL (Pure)		0.17	8[k]	32_p - 53_n	0.150_n 0.184-0.23_n	0.434	3.03	0.19	0.42	45.2
TETRYL/Graphite				27_p-48_n	0.150_q				0.32	
TETRYL/Graphite/Stearate (total 2%)										
RDX		0.13	8[k]	18_m - 29_n					8.58	
(44 micron particle size)				21_n - 22_n	0.335_q					
Type A				24_n-27_p	0.413_q				100	
Type B				20_n	0.318_q				100	
Type B - Class C (pellet grade)				21_n	0.229_q	0.470	3.28	0.05	100	
									8.93	
RDX/Wax 99/1				34_n						
98/2				35_n						
97/3 (Comp. A-4)			11[j]	43_n						
95/5				47_n						
91/9 (Comp. A-3)		0.21	10[k]	78_p-80_p	0.062_s					
RDX/Calcium Stearate								Approx 0.4[j]	3.14	53.0
99.3/0.7						0.392	4.07	0.05		
98.6/1.4				23_n		0.332	4.79	0.04		
98/2			9[j]*	28_q-37_n	0.144_q	0.313	5.04	0.06		
97.2/2.8				32_n		0.299	5.25	0.10		
RDX/Ca Stearate/PIB/Graphite				24_m-44_n	0.140_q	0.384	4.39	0.11	0.56	
(97.5/1.5/0.5)-(CH-6)									0.52	
97.75/1.45/0.75/(CH-4)				26	0.114_q					
PB - RDX			15[j]	40_p				Approx 0.35[j]		
PENTOLITE 50/50	0.21	0.13	12[k]	27_n-38_p	0.290_n					2.02
10/90			14[k]							
COMP B	0.33	0.19	14[k]	59_n-82_p	0.10_n(pressed)	0.2[illegible]	5.75 cast			
COMP B (Unwaxed)	0.27	0.17								10.7
CYCLOTOL 75/25			14							
TETRYTOL 70/30	0.31	0.19								23.6
75/25			10[k]							
TNT	0.7	0.5	14.5[k]	172_p-230_m	0.070_n	0.381	5.5 pressed			
						0.021	10.7 cast			28.6

a. Minimum priming charge (cap of DBNP to initiate charges pressed to density = 1.4 gm cc. Cast charges at practical cast density. From OSRD Report No. [illegible].

(b.) ERL type 12 tool 2.5 kg wt. (cm).

(d.) Critical Ineite Gap between 0.[illegible] dia x 1.00 long RDX Donor and Acceptor (both pressed in steel at 10,000 psi). Private Comm. J.N. Ayres, NOLW

j. PATR 2479

k. PATR 1740 incl. Suppl. 1

m. NAVORD Report 4394

n. NAVORD Report 4212

p. NAVORD Report 2940

q. NAVORD Report 4320

s. NOLM 10577

** RDX/Stearic Acid

The attractive features of RDX as a booster explosive do not include its loading properties. Pure RDX requires very high loading pressures to approach within five or ten percent of its crystal density. Pressed at reasonable pressures the relatively low density pellets crumble at the edges when handled. Pressed at 40,000 to 50,000 psi to attain reasonably high loading densities, pellets of the sizes used in boosters tend to striate as they are extruded from the molds. In some cases, they break into flakes upon extrusion, in others they break when handled. A "pelleting grade" of RDX which contain a bimodal distribution of particle sizes designed for maximum packing efficiency forms denser, stronger pellets. The addition of stearates, stearic acid, or waxes further improves some of these properties. However, the waved material tends to become sticky as the loading tools warm up, while the material with stearic acid or stearates retains much of the brittleness of pelletized RDX as compared with tetryl. The explosive CH-6, which is a mixture of RDX/calcium stearate/polyisobutylene/graphite in the proportions 97.5/1.5/0.5/0.5 is the result of an effort to duplicate the properties of tetryl with respect to sensitivity and loading characteristics while retaining the higher output of RDX.

Many recently developed Navy boosters specify CH-6. Army designs call for RDX with 2% stearic acid added.

PBX, the initials of "Plastic Bonded Explosive", is a broad generic term which has been applied to a wide variety of materials of this general description. The original PBX's were mixtures of RDX with about ten percent of polystyrene highly plasticized with dibutyl phthalate. During the past five years or so a number of interesting materials have been developed employing a variety of resins, notably nylon, nitrocellulose, and phenol-formaldehyde. Most of them use RDX as the explosive component, but, for special applications, other explosives have been used and in some cases aluminum is added. When pressed hot at relatively high pressures, these materials acquire physical properties which resemble those of molded plastics rather than pressed powders. However, in this condition they are somewhat less sensitive to initiation than tetryl so that explosive trains designed for tetryl boosters will not necessarily be initiated reliably if hot pressed PBX is substituted. The output of hot pressed PBX, though reduced somewhat from that of more concentrated RDX, is appreciably greater than that of tetryl.

Although PBX is intended to be hot pressed, many of these materials may be pressed cold in automatic presses. The pellets so obtained are appreciably stronger than tetryl pellets, though of somewhat lower density. The lower density almost exactly cancels the higher output potential of the RDX and the desensitizing effect of the resin to produce a material very similar to tetryl in both sensitivity and output.

Granular TNT at its bulk density or pressed at a few hundred pounds per square inch is sufficiently sensitive for use as a booster in systems designed for it and has been so used in early underwater ordnance. Because of the low density TNT, these boosters were necessarily quite large. A pound or two was not uncommon. Under high temperature storage, the TNT sometimes settled or shrank to leave large voids and became so insensitive that failures were not uncommon. This type of booster is not recommended except as a "jury rig" where a charge is to be detonated shortly after preparation.

The casting of boosters would be quite attractive from a production point of view, particularly for limited volume items such as guided missile, mine or torpedo boosters. However, castable explosives are generally too insensitive for use with usual fuze trains. Cast TNT which is less sensitive than most main charge explosives is unlikely to be considered as a booster explosive. Composition B and other castable mixtures containing large proportions of RDX and TNT have been used in some underwater ordnance. Such a booster is usually initiated by means of a "sub-booster" which may be larger than the booster of other types of ordnance. The cast main booster of such a system is frequently of the same order of sensitivity as the main charge and hence superfluous. A possible justification for its retention might lie in the flexibility it allows in the choice of main charge. Amatol, minol, minex, DBX, and tritonal, materials which may be substituted for the higher performance explosives, are appreciably less sensitive than Composition B, HBX, or, in some cases than pure TNT (see Table II). Of the commonly available castable explosives, pentolite approaches tetryl most closely in sensitivity. Both Tritonal and pentolite have been used as a booster, but less frequently because relatively poor thermal stability has prevented the widespread application these substances might otherwise have had.

Cast boosters are usually cast directly into their containers although it is possible to cast them in molds to intricate shapes if desired. The casting of high quality charges of any kind is an art involving compromises which, at the present, require highly developed subjective judgment. A material cast at a high enough temperature to be very fluid will, of course, flow to fill the mold quite completely. However, such high temperature casting results in settling or other displacement of suspended solids (such as RDX or PETN), excessive shrinkage on cooling, and the growth of very large crystals in which it is more difficult to initiate detonation from a small source and which tend to have lower reaction rates even in stable detonation. A technique which results in uniform composition, minimized shrinkage, and very fine crystallization is that of "cream casting". "Cream casting" consists essentially of stirring the materials as it cools in the melting kettle or a separate blending kettle until it starts to solidify, casting at the last possible instant compatible with complete filling of the case or mold. With this technique in mind, it is always well for a designer to allow as large filling holes as possible.

THERMAL STABILITY

As metastable chemical compounds and mixtures, all explosives decompose continuously from the time they are synthesized or mixed. This decomposition becomes more rapid with rising temperature. A requisite feature of a useful explosive is that the rate of this decomposition be so low as to preclude undesirable effects before it is purposely initiated. The undesirable effects of too rapid decomposition fall into the two categories: deterioration and "cook-off" (thermal explosion). At even the extremes of the expected storage conditions for military stores the commonly used booster explosives (with the possible exceptions of PETN and pentolite) will survive almost indefinitely without perceptible deterioration. The "cook-off" problem is more difficult. Thermal explosions of a number of rounds have been traced to the booster. PETN is not used as a booster explosive except under special circumstances.

A thermal explosion occurs when heat is liberated by the reaction of an explosive more rapidly than it can be dissipated from the charge. Since the reaction rate almost invariably increases more rapidly with rising temperature than the heat dissipation rate, this situation is extremely unstable. Theoretical computations of conditions for thermal explosion can be made only on the basis of simplifying assumptions which ignore such important aspects as the effects of interstitial convection, autocatalysis, and the substantial change in reaction rate which occurs at the melting point. However, the range of sizes and degrees of confinement of boosters is so limited and the reaction rate is so sensitive to temperature changes, that a "cook-off temperature" may be assigned to each explosive which is quite generally applicable to boosters. It happens, for PETN, tetryl, RDX, and HMX to fall quite close to the melting point. As the temperatures to which explosive ordnance is exposed continue to increase, tetryl has been displaced, in some items by RDX, and RDX by HMX. It may be anticipated that HMX will in turn be displaced by still more stable materials.

ECONOMIC AND LOGISTIC FACTORS

Booster explosives, in general, comprise such a small fraction of the total charge in an ordnance item that the cost of the explosive is not particularly significant. However, the relatively small volume of booster explosive used does make it undesirable to maintain and operate special separate facilities for their production. No tetryl is being produced in the United States today, to the knowledge of the writer. Current production of tetryl boosters is from stock left over from World War II. The fact that tetryl is specified for many boosters and similar devices makes it necessary to maintain a number of tetryl plants in standby condition. Widespread substitution of RDX or its mixture for tetryl in future production, and in new fuze explosive train design, would eliminate the need for these standby plants and make them available for conversion to the production of some of the newer explosives for special application while requiring a nearly negligible increase in the production of RDX.

SHAPE AND SIZE OF BOOSTERS

Most boosters are cylindrical pellets with length - diameter ratios close to unity. As has been pointed out, the most important distinguishing characteristic of a booster is its size. A survey of the sizes of boosters used in ordnance leads to the conclusion that the size of a booster is more or less directly related to the size of the weapon in which it is used. From the foregoing discussion, relating booster size to the properties of explosives, one might be led to ask why a larger charge should require a large booster. It shouldn't.

The relationship of booster size to weapon size has its origin in the compromise between the desirability of allowing maximum flexibility in the choice of main charge material and that of limiting the size of a booster to some reasonable fraction of the size of the weapon. The more effective a booster, of course, the wider the choice of main charge materials. On the other hand, enlargement of a booster almost always displaces more main charge explosive than is added to the booster. Furthermore, the booster explosive usually lacks some of the specific properties which led to the choice of the main charge explosive.

Seeger[12], has shown that a one half inch by one half inch pellet of either tetryl or RDX is sufficient to initiate TNT and even tritonal, when the pellet is detonated after insertion in a close fitting cavity in the main charge explosive. However, a one by one inch cylindrical pellet failed consistently to initiate cast TNT when in end to end contact.

The heavy steel cups in which boosters are often loaded can decrease their effectiveness. On the other hand, booster cups have been employed to substantially augment the effectiveness of the boosters they house.

The transmission of detonation is discussed in more detail in Chapter V of the ORDP on Explosive Charge Design and the design of Boosters in Chapter XIII of that ORDP, which is now in preparation.

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